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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G08B 5/22, 13/19, H04Q 1/00, 7/00, H04B 1/16 — A1

(11) International Publication Number: WO 98/49661

(43) International Publication Date: 5 November 1998 (05.11.98)

(21) International Application Number: PCT/US98/08333

(22) International Filing Date: 24 April 1998 (24.04.98)

(30) Priority Data:
08/845,912 25 April 1997 (25.04.97) US

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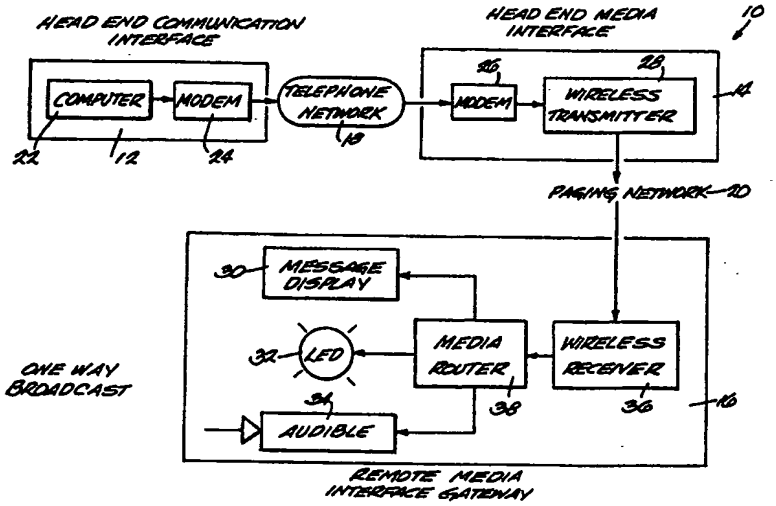
(81) Designated States: AU, CN, JP, NZ, RU, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: EMERGENCY MESSAGING SYSTEM



(57) Abstract

An emergency notification system (10) using selective call communications techniques is provided for communicating human and property safety information to and from recipients scattered over wide geographic areas. A computer controlled head end communications interface (12) adds subaddress information to a message to target intended recipients. A media router (38) directs the message through appropriate transport media in accordance with the address information. Preferably, the messages are communicated, at least in part, over existing paging systems. Additional transport media include existing power distribution networks, twisted wire pairs and fiber optics networks. Bi–directional reporting capability is provided. The system is well–suited for the communication of emergency notifications and warnings.

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EMERGENCY MESSAGING SYSTEM

RELATED APPLICATION

This is a Continuation-in-Part of U.S. Patent Application Serial No. 08/696,014 filed August 20, 1996.

BACKGROUND OF THE INVENTION

This invention relates generally to emergency notification systems and, more particularly, to systems for communicating human and property safety, address-specific, limited content messages in one or two directions via selective call communications links.

The need to communicate address-specific, limited content data messages over wide areas arises in emergency situations is growing. Since 1934, people have been dependent on outdoor warning siren systems, initially implemented for national security reasons. In 1951, siren systems were formally organized nationwide as a Civil Defense warning method. Since that time, however, sirens have become antiquated and at times function poorly. Urban growth has outstripped coverage in other cases. Other limitations of siren emergency warning systems include (a) they are not heard inside shopping malls or on factory floors, (b) they make noise but do not deliver information or instructions, (c) performance is affected by weather conditions, (d) they malfunction frequently and have high maintenance and replacement costs, and (e) they do not reach the deaf or hearing impaired.

Another civil warning system is based on the commercial radio and TV broadcast stations. The Emergency Broadcast System (EBS)/Emergency Alerting System (EAS)(a) does not reach people when they are asleep, (b) reaches only those listening to radio or watching television, (c) does not reach hearing impaired, (d) depends upon voluntary broadcaster participation, (e) limited when radio stations are day-time only or automated during the night, (f) limited when news/weather departments are unmanned at night, (g) relies on unreliable daisy-chain alarm technology. (EBS),(h) depends greatly on human performance, (i) does not function without AC power, and (j) does not serve people in shelters unable to access television and radio.

The Nation Oceanic and Atmospheric Agency's (NOAA) weather radio system is another civil warning system. It is limited by (a) its need for a special radio, (b) spotty geographic signal coverage, (c) the small percentage of users in general population, (d) weather only information, (e) does not reach hearing impaired, (f) signals are adversely affected in locations such as basements or heavily wooded areas.

While the message distribution systems of EAS and other existing emergency systems do preface messages with message source, coverage area, and other control information, this control information cannot precisely target many local, limited area, or arbitrary boundary emergency situations. The control information is suited for wide area situations and was designed primarily for use by news broadcast and other media rather than general public.

Existing emergency notification systems are

also limited by other factors including dependence on AC power. When evacuation of a population segment is required and AC power outages are widespread, the only option currently available to emergency managers is a slow and lengthy door-to-door, or block-by-block notification process. The delayed notification increases the potential for loss of human life. In addition in the case of hazardous material incidents, slow general population protection efforts often delay containment efforts increasing containment and/or remediation costs.

In past major disasters, people accepted as the norm, informational delays, rumors, power outages (eliminating TV/Radio services), uncoordinated governmental delivery systems and inaccurate information. They accepted the limitations of existing communications systems. But expectations of the general population increase as the Internet, satellite TV and other rapid communications appliances become ever more commonplace. Political fall-out has been considerable where evacuation announcements and efforts have not reached everyone in a timely manner.

The EAS/EBS and other existing emergency warning systems are valuable aids to emergency managers but such broadcasts, effective as they are in transmitting information over a wide area, are, by nature, not address specific. Accordingly, they are transmitted equally to those who are affected by the crises as well as to those who are not. Although address-specific, wire-based communications links, such as private telephone lines have existed for years, the cost of providing dedicated lines for

relatively limited communications needs is prohibitive.

One form of existing wireless communications that solves part of the address-specific message targeting problem is the radio paging system of known configuration. Such selective call radio systems combine the speed and coverage of wireless "broadcast" techniques with the address-specific capabilities of wire-based systems. Such paging systems are also configured for the address-specific transmission of limited data messages. Accordingly, wireless paging systems can be well suited for providing cost-effective, efficient and immediate, limited communications between for example, utilities and police, fire and disaster control authorities on the one hand, and widely dispersed community residents on the other.

Unfortunately, existing radio paging systems are not a total solution for emergency notification. Paging systems commonly use receivers that recognize a limited number of single level address selection (variously Code Assignment Plan (CAP), or Capture) codes. Because of these and other technical limitations, emergency managers have generally restricted radio paging and other selective call system usage to emergency and political personnel.

SUMMARY OF THE INVENTION

The invention provides a method of operating a wireless system so as to communicate messages to specific groups among a plurality of potential message recipients according to the presence or absence of the potential message recipients within a specified geographic area. The method comprises the steps of equipping each of the

potential message recipients with a wireless receiver operable to receive encoded geographic coordinates and to determine presence or absence within an area defined by the received encoded geographic coordinates, identifying the geographic coordinates defining the specific geographic area to which the group specific message is directed, transmitting to each of the receivers a message containing an informational portion and a portion containing the geographical coordinates of the specified geographic area, determining at each of the receivers presence or absence within the specified geographic area, and displaying the informational portion of the message at the receivers determined to be within the specified geographic area.

The invention also provides a method of operating a wireless communications system having a plurality of receivers each responsive to a common base address and to a unique individual address. The method comprises the steps of generating for each of the receivers a unique identification code, locating each of the receivers at a specific geographic location, generating for each of the receivers a location code indicative of the specific geographic location associated with the receiver, and communicating via a wireless communications link the unique identification code and the location code to respective ones of the receivers.

In one embodiment, the method comprises the further steps of relocating a receiver to a different geographic location, generating a new location code indicative of the receiver's different geographic location, and communicating via a wireless communications link the new location to the

relocated receiver.

The invention also provides a method of operating a wireless system so as to communicate group specific messages to specific groups among a plurality of potential message recipients. The method comprises the steps of identifying specific groups among the plurality of potential message recipients, assigning to each of the identified specific groups a group specific address, equipping each of the potential message recipients with a wireless receiver responsive to the group specific address of the specific group to which the potential message recipient belongs, generating a message containing an informational portion and an address portion, the address portion including the group specific address of the specific group intended to receive the message, transmitting via a wireless signal the message over a geographic area containing the potential message recipients so that the receivers responsive to the group specific address will accept the message and communicate the informational portion of the message to the member of the specific group, and verifying the existence of authority to transmit the message to the specific group before transmitting the message to the specific group.

The invention also provides a method of operating a wireless system so as to communicate group specific time sensitive messages to specific groups among a plurality of potential message recipients. The method comprises the steps of identifying specific groups among the plurality of potential message recipients, assigning to each of the identified specific groups a group specific address, equipping each of the potential message

recipients with a wireless receiver responsive to the group specific address of the specific group to which the potential message recipient belongs, generating a message containing an informational portion, an address portion, and a time duration portion, the address portion including the group specific address of the specific group intended to receive the message, transmitting via a wireless signal the message over a geographic area containing the potential message recipients so that the receivers responsive to the group specific address will accept the message and communicate the informational portion of the message to the member of the specific group, decoding the time duration portion of the message to define a time period, and deleting the informational portion of the message following expiration of the time period.

In one embodiment, the method comprises the further step of resetting each of the receivers following expiration of a predetermined time interval.

The invention also provides a receiver unit for use in a pager-based communications system operable to direct messages to specific groups of pagers within a larger group of receivers within the service area of the system. The receiver unit comprises a wireless receiver responsive to a base address, a decoder coupled to the wireless receiver for recognizing a group-identifying indicator indicative of inclusion within the specific group, an audible alarm annunciator responsive to the wireless receiver and the decoder for sounding an audible alarm in the event of receipt of an alarm message directed to the receiver unit, and control circuitry for silencing the audible alarm after

passage of a predetermined time period following receipt of the alarm message.

In one embodiment the control circuitry is further operable to reduce the audio level of the audible alarm in response to appropriate control signals received from the wireless receiver.

The invention also provides a method of operating a wireless comunications system. The method comprises the steps of generating a message having a base address portion, a control instruction portion and an informational portion, transmitting the message via a wireless signal, receiving the transmitted message on a receiving unit operable to respond to messages containing the base address, decoding the control instruction portion of the message and, in response to receipt of an appropriate decoded control instruction, thereafter transferring the informational portion of the message to a different paging system for distribution over the different paging system.

The invention also provides a receiver unit for use in a pager-based communications system operable to direct messages to specific groups of pagers within a larger group of receivers within the service area of the system. The receiver unit comprises a wireless receiver responsive to a base address, a decoder coupled to the wireless receiver for recognizing a group-identifying indicator indicative of inclusion within the specific group, an audible alarm annunciator responsive to the wireless receiver and the decoder for sounding an audible alarm in the event of receipt of an alarm message directed to the receiver unit, and control circuitry for silencing the audible alarm after passage of a predetermined time period following

receipt of the alarm message.

The invention also provides a receiver unit for use in a pager-based communications system operable to direct messages to specific groups of pagers within a larger group of receivers within the service area of the system. The receiver unit comprises a wireless receiver responsive to a base address, a decoder coupled to the wireless receiver for recognizing a group-identifying indicator indicative of inclusion within the specific group, circuitry coupled to the decoder and the wireless receiver for recognizing an informational portion of a message directed to the specific group of receivers, and additional circuitry responsive to an informational input received independently of the message directed to the specific group of receivers.

In one embodiment, the informational input comprises a signal indicative of the geographic location of the receiver unit.

In one embodiment, the informational input is obtained from a global positioning system receiver.

In one embodiment, the informational input is derived from a sensor located in the vicinity of the receiver unit.

In one embodiment, the sensor is selected from the group consisting of baby monitors, telephone monitors and door bell ring detectors.

In one embodiment, the receiver unit further includes a memory for storing one or more previously recorded messages and a display for displaying the previously recorded message in response to receipt of an appropriate informational input.

In one embodiment, the receiver unit

further includes a non-aural based indicator for indicating receipt of an informational input.

In one embodiment, the receiver unit further includes an alternate source of operating energy.

In one embodiment, the receiver unit further includes the alternate source comprises a battery-operated power supply.

In one embodiment, the receiver unit further includes a light source actuated upon actuation of the alternate source.

It is an object of the invention to provide a new and improved system for communicating with specific groups among a plurality of geographically dispersed potential recipients.

It is a further object of the invention to provide a communications system that permits communication with specific ones of several remote sites in a geographic area while utilizing existing, low-cost communications media.

It is a further object of the invention to provide a communications system that permits remote accessing of data generated at various specified ones of a plurality of remote sites dispersed over a geographic area.

It is a further object of the invention to provide a communications system that permits automatic communication of an alarm or other such non-scheduled message automatically from a remote site to a central location using existing, low-cost communications media.

It is a further object of the invention to provide a communications system that permits remote control of specific remotely located devices over a wide geographic area using existing, low-cost

communications media.

It is a further object of the invention to provide a communications system that includes a media routing feature that provides for communications through various available media in accordance with the type, location and nature of communication needed.

It is a further object of the invention to provide a communications system that incorporates a logic protocol feature for translating between the logic/application level protocols of different physical media.

Brief Description of the Drawings

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with the further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, wherein like reference numerals identify like elements, and wherein:

FIGURE 1 is a simplified block diagram of a one-way, pager-based communications system embodying various features of the invention

FIGURE 2 is a simplified block diagram of a one-way, pager-based alarm reporting communications system embodying various features of the invention.

FIGURE 3 is a simplified block diagram of a pager-based, two-way meter reading communications system embodying various features of the invention.

FIGURE 4 is a simplified block diagram of a pager-based, one-way remote control communications system embodying various features of the invention.

FIGURE 5 is a simplified block diagram of a first embodiment of a logical/application protocol conversion system embodying various features of the invention and useful in conjunction with the pager-based communications systems herein disclosed.

FIGURE 6 is a simplified block diagram of another embodiment of a logical/application protocol conversion system embodying various features of the invention and useful in conjunction with the pager-based communications systems herein disclosed.

FIGURE 7 is a simplified block diagram of one form of network operable to interconnect the communications elements of two separate devices coupled to different lines of a three-wire power distribution system.

FIGURE 8 is a simplified block diagram of another form of network operable to interconnect the communications elements of two separate devices coupled to different lines of a three-wire power distribution system.

FIGURE 9 is a simplified block diagram of a switchable network embodying various features of the invention useful in interconnecting the communications elements of various devices coupled to different lines of a three-wire power distribution system.

FIGURE 10 is a simplified block diagram of an alternate embodiment pager-based communications system offering still further flexibility in directing various types of communications to and from various ones or subgroups of receivers within a paging area.

FIGURE 11 is a simplified geographic depiction of a coverage area serviced by a pager-based communications system, useful in understanding

one approach to communicating with receivers located within a selected sub-area located within the broad coverage area.

FIGURE 12 is a simplified block diagram, similar to FIG. 1 of an alternate embodiment of a one-way pager based communications system embodying various features of the invention.

Description of the Preferred Embodiment

Referring to the drawings and, in particular, to Fig. 1, a simplified block diagram of a pager-based communications system 10 is illustrated. In accordance with one aspect of the invention, the system 10 is configured to communicate information from a central location to a specific group of potential message recipients scattered over a wide geographic area. In the illustrated embodiment, the system is particularly well suited for use by public safety departments, disaster warning agencies and the like to transmit limited, content specific messages to particular groups of recipients among a larger group of potential recipients. For example, the system can be used by a metropolitan disaster agency to warn particular residents of a community (e.g. those residents living in the flood plain of a river) of an impending situation affecting only those residents (e.g., imminent flooding along the river). Although a signal is broadcast over the entire community and, hence, is potentially receivable by every member of the community, the system 10 functions automatically to direct the message to the affected members without also directing the message to the unaffected members. This helps ensure that the affected members receive the message and also helps avoid "bothering" the unaffected members with

a message that does not concern them. In accordance with a principal aspect of the invention, the system is easily and economically implemented using substantially existing communications media that are already in place.

In the illustrated embodiment, the system 10 includes a head end communication interface 12, a head end media interface 14 and a remote media interface gateway 16. The head end communication interface 12 communicates with the head end media interface 14 via a telephone network 18 of known construction, and the head end media interface communicates with the remote media interface gateway 16 via an existing paging network 20, also of known construction. In the illustrated embodiment, the head end media interface actually makes up part of the paging network and can be of conventional, known construction. The head end communication interface 12 originates the message to be communicated to the specified group of potential recipients and includes a computer 22 coupled to the telephone network through a modem 24. Although an existing telephone network 18 is contemplated, it should be understood that the particular type of system used is not critical to the invention, and that other forms of existing and future communications systems, i.e., analog or digital, wireless personal communications, coaxial, broad-band fiber, optics etc., can be used.

It is assumed that specified groups of potential recipients have been previously identified according to some selection criteria. For example, potential recipients can be classified according to such factors as (a) physical location within the geographic area or(b) membership in an emergency response organization, utility or municipal crew,

media outlet, etc. In any event, the potential recipients are classified according to group and are assigned a unique identifier or "subaddress" unique and common to members of the specific group. The particular classification or assignment of group is not critical to the invention, and the types of classifications herein referenced are for illustrative rather than limiting purposes.

The computer 22 functions to keep track of the specific groups and their unique addresses and further functions to add the appropriate address to messages intended for specific groups. Thus, if a message is to be sent to a specific group of potential recipients, the computer identifies the appropriate address and incorporates the address into the message. The message with the incorporated address is then communicated through the modem 24 and existing telephone network 18 to the head end media interface 14. The head end media interface 14 includes a modem 26 that receives the message with the incorporated address and supplies both the message with the incorporated address to a wireless transmitter 28 for broadcast over the paging network 20.

In accordance with another principal aspect of the invention, the address information that identifies the specific group to receive the message is added into the message and is in addition to the single operating base address that is procured from the pager service provider. Thus by incorporating the group-specific address information into the message itself, the system 10 allows single device or pre-determined grouping of several devices using a single operating base address. Because only a single base address need be procured from the pager

service provider, considerable economy is realized.

The system 10 allows an emergency management agency to target specific operating areas based on operational or warning needs. The remote media interface gateway functions to route the message, after its receipt by the targeted group member, to an appropriate display based on the type of message received. For example, the remote media interface gateway can include various types of displays, such as an alphanumeric display 30, an LED display 32 and an audible warning 34, coupled to a wireless receiver 36 through a media router 38. After the message is received by the wireless receiver 36, the media router interprets additional information coded into the message to determine the nature of the message and direct the message to the appropriate display. Warnings of severe weather or other emergency conditions can be displayed alphanumerically while the audible warning attracts the recipient's attention with a sound level and pattern indicating message urgency. The audible warning could be used, for example, to alert the user to view the detailed information appearing on the message display 30. Preferably, the various indicator devices 30, 32 and 34, and the media router 38 and wireless receiver 36, are all integrated into a single unit comprising the remote media interface gateway 16.

Referring to Fig. 2, another system 40 embodying the invention is illustrated. In this system 40, communication from a remote site back to a central location is provided. The system 40 includes a head end communication interface 12 coupled to a telephone network as in the previously described system 10 of Fig. 1. In addition, the

system 40 includes a head end media interface 42 that has a wireless receiver 44 coupled to the telephone network 18 through a modem 46. The system further includes a local network function module 48 and a remote media interface gateway 50 coupled to the local network function module through some form of transport medium. As used herein, such a transport medium is intended to include any medium through which electrical or optical signals or energy can be transported from one location to another and includes, for example, power distribution networks and wiring, telephone or data communication networks, wireless links, optical fibers and the like. The remote media interface gateway communicates with the head end media interface 42 through a paging network 52 having a wireless transmitter 54 associated with the remote media interface gateway 50 and a wireless receiver 44 associated with the head end media interface 42.

The system 40 is particularly well suited for communicating a signal, such as an alarm signal or serial data stream, from a remote location to a central location such as a police station or private security headquarters. In accordance with one aspect of the invention, the system 40 makes use of existing links, such as power wiring, to communicate signals to and from the remote location. To this end, the local network function module 48 includes a control input and output circuit 56 that receives an alarm function 58 from an appropriate source, such as, for example, a burglar or fire alarm, and generates an appropriate alarm message incorporating the location of the emergency as well as its nature. The message is supplied to the available transport medium 60, such as the power line network, for

transmission to the remote media interface gateway 50. The remote media interface gateway 50, which is located remotely from the local network function module 48, receives the message through an appropriate transport medium input port 62 that is coupled through a media router 64 to the wireless transmitter 54.

The wireless transmitter 54 transmits the message over the paging network 52 back to the wireless receiver 44 of the head end media interface 42. The message thus received is communicated through the modem 46, the telephone network 18 and the modem 24 to the computer 22 of the head end communication interface 12.

To facilitate communication, enhance economy and provide system flexibility, the system 40 "keeps track" of the various communications media through which the various remote locations and their associated local network function modules 48 are interconnected with the remote media interface gateway 50. For example, those remote locations that are interconnected through the power distribution network (transport media #1) are categorized according to type and designated with a particular address element that is recognized by the media router 64. When a message intended for or received from a remote site connected through the power distribution network is to be communicated, the media router selects the appropriate transport medium, in this case medium # 1. Other remote sites might be coupled to the remote media interface gateway 50 through other media such as a wireless link (transport medium #2). Messages from or to such remote sites are directed, through the media router 64, to the appropriate transport medium, in

this case transport medium #2. By utilizing existing communications links, the system 40 permits one-way alarm reporting in an economical manner. When a message from a remote site is received and routed back to the head end communication interface, the computer decodes the message as to type (fire, security breach etc.) and location and directs an appropriate display to the proper personnel.

Referring to Fig. 3, another system 66 embodying the invention is illustrated. System 66 is particularly well suited for requesting and receiving data from remote locations dispersed over a wide geographic area. In this system 66, a head end communication interface 68 having a computer 22 and a modem 70 operable in a bi-directional mode is used as is a head end media interface 72 having a bi-directional modem 74, a wireless paging transmitter 76 and a wireless paging receiver 78. The head end communication interface 68 and the head end media interface 72 communicate through the telephone network 18. A remote media interface gateway 80 is provided that includes a wireless transmitter 82 and a wireless receiver 84 that are coupled to a media router 86 that in turn is coupled to one or more transport media 62, such as the power distribution network. Finally, the system 66 includes, at one or more remote sites, one or more local network function modules 88. The local network function module 88 includes an interface 60 to the connected transport medium and further includes a control input and output circuit 90 and, in the illustrated exemplary embodiment, a usage meter 90. The usage meter 92 comprises an electric consumption meter and is shown only as an example and not as a required element of the invention. In

the illustrated embodiment, the system 66 enables a centralized agency, such as a power utility company, to read electric power consumption meters located at remote sites from the central location and without having to send personnel to the remote site.

In operation, the system 66 first generates a page at the head end communication interface 70 that is communicated through the telephone network 18 to the head end media interface 72. The computer 22 generates an appropriate address indicative of the remote site to be interrogated as well as an appropriate interrogation request. The message thus generated is transmitted via the wireless transmitter 76 to the remote media interface gateway which decodes the proper address and message request type. The media router 86 directs the message request through the appropriate transport medium to the local network function module 88, which decodes the request and obtains the requested information. The local network function module 88 then communicates the requested information back through the appropriate transport medium to the remote media interface gateway 80, that, in turn, transmits the requested data to the head end media interface 72 for further communication back to the head end communication interface 68. In each case, proper routing address information would be incorporated into both the message sent to the local network function module 88 and in the return message sent back to the head end communication interface 68 from the remote location. The head end communication interface 68 would then organize the information by displaying the initial meter reading request for a given address with the actual reading received. Alternatively, the reporting function can occur as

part of a pre-determined schedule, protocol or other plan rather than through direct request.

Referring to Fig. 4, another system 94 embodying various features of the invention is shown. This system 94 permits remote command of remotely located devices from a central location. In particular, the system provides for sending a specific control command to a remote device and meets two immediate needs. The first is to enable a remote authority, such as, for example, a power utility company, to remotely control devices, such as water heaters or air conditioners, so as to enable the power utility to change demand at times of peak load. The second is to enable a user to control devices, such as a residential heating system, from a remote location.

The system 94 is similar to the one-way broadcast system of Fig. 1 and includes the head end communication interface 12, the telephone network 18 and the head end media interface 20. The system further includes a remote media interface gateway 96 including a wireless receiver 84, media router 86 and various transport media 62, such as a power distribution network. Finally, the system 94 includes a local network function module 98 that, like that of the system 66 shown in Fig. 3, includes a transport medium interface 60 and control input and output circuit 90, but has a load control 100 coupled to the control input and output circuit 90. The load control 100 is operable, in response to applied external commands to control an external load or device.

In operation, a page is sent from the one-way head end unit 12 and the head end media interface 14 with the transmitter 28 first sending

the data to the remote media interface gateway through the paging network 20. The remote media interface gateway 96 decodes the proper address and control message type and/or function and then routes the request through the proper local transport medium, such as a power line, to the local network function models 98. The local network function module 98 decodes the message and turns the device on or off as required.

In the system 94, the communication is one-way from the head end media interface 14 to the remote media interface gateway 96. The head end communication interface organizes the information by matching the remote address location and control function type by displaying the address with the actual control function desired. The needs met by the system 94 require the ability to reach a wide range of remote locations organized by specific groups or even a single location. The reception/address information is contained in the actual message and is decoded by the remote media interface gateway 96. Existing paging systems operate by sending a single base address to a single receiver. By adding additional address information into the message, the system 94 allows single device or pre-determined grouping of several devices using a single operating base address. This provides a great economic advantage in that only one base address need be procured from a pager service provider. The system 94 enable a utility to target specific operating areas based on operational needs, such as electrical load to be shed.

In accordance with still another aspect of the invention, capability is provided for performing logic/application level protocol translations

between different physical media where required to execute various services. This allows components of different manufacturers to be interconnected into a single interoperable system. For example, security sensor operational alarms on an Echelon LonTalk system can be passed to a X.10 Bus lighting system so that outdoor lights can be turned on when an alarm transmission is generated by the remote media interface gateway as part of reporting a transmission to the head end communications interface. Such an approach is shown in the system 102 of Fig. 5 wherein a remote media interface gateway 80 of the type shown in Fig. 3 communicates with a plurality of local network function modules 88, 88' and a logical protocol conversion takes place between the two local network function modules 88, 88'. A similar system 104 is shown in Fig. 6.

Referring to FIG. 6, the system 104 includes a remote media interface gateway 112, which includes a control processor 110 coupled to the media router 86 but is otherwise similar to the remote media interface gateway 80 shown in FIGS. 3 and 5. A security sensor 106 coupled to an Echelon LonTalk transport medium 108 is coupled to the control processor 110. When the security sensor 106 detects an alarm condition, the alarm message thus generated is transported to the control processor 110 through the media router 86 to the wireless transmitter 82. The transmitter 82 sends the alarm message to a remote head end communication interface 22 (Fig. 3). The control processor 110 recognizes the security sensor 106 operation as an alarm condition and matches this sensor operation to a logical look-up table in the attached memory 113. The table indicates that, when the sensor 106

operates, a lighting control function (i.e., turn on the light) is desired. A functional module 114 is coupled to the light and is also coupled to the media router 86 through the second transport medium 116. In this example, two logical functions are connected between two different physical media that are not directly compatible at the physical level.

As previously noted, the various communications systems disclosed herein make use of the power distribution system as an important available transport medium. Typically, power is distributed by means of a three-wire system having two "hot" lines, L1 and L2, and one neutral line. Typically, 240 V power is available across lines L1 and L2 while 120 V power can be obtained between either of the lines L1 or L2 and neutral. Because the communications systems disclosed herein might require communications between devices coupled to different lines of the power distribution system, various coupling networks are provided for permitting such communication.

FIG. 7 shows a system 118 for permitting power line communication between devices that operate on 120 VAC and that are connected to the neutral line and different ones of the "hot" lines, L1 and L2. In this system, a coupling capacitor 122 couples a transport medium transceiver 124 to both lines L1 and L2. High frequency signals transmitted by the transceiver 124 thus appear on both of the lines L1 and L2.

FIG. 8 shows a network 126 suitable for permitting communications between devices that operate at 240 VAC and that are coupled between both of the lines L1 and L2. In this system 126, the transport medium transceiver is simply connected to

both of the lines L1 and L2.

Neither of the systems 118 or 126 permits communications between all devices regardless of whether they are connected between L1 and neutral, L2 and neutral or between L1 and L2. Accordingly, and in accordance with one aspect of the invention, a switchable interface network 128 is provided. The system 128 includes a controllable medium switch 130 that is connected as shown. In the system 128, lines L1 and L2 are coupled, at signal frequencies, by the capacitor 122. One side of the transport medium transceiver 124 is coupled directly to line L2 and, through the capacitor 122, to line L1. The other side of the transport medium transceiver 124 is connected to the common pole of the medium switch 130. The medium switch 130 functions to couple the transport medium transceiver 124 to either the neutral line or to line L1. When the medium switch 130 is in a first position, position 1, the transport medium transceiver 124 is coupled to the neutral line and hence is configured for communications with 120 VAC devices coupled between lines L1 and L2 and neutral. When the medium switch 130 is in the opposite position, position 2, the transport medium transceiver 124 is configured for communications with 240 VAC devices connected across line L1 and L2. The medium switch 130 is under the control of the media router 86 (FIGS. 3-6) which sets the medium switch 130 as required for the desired communication. The system 128 thus provides complete flexibility for communications via the power lines among various different, and differently connected, devices.

Still another pager-based communications system 200 embodying various features of the

previously described systems is shown in FIG. 10. In this system 200, further flexibility in communicating to and from selected subgroups of users is provided.

In FIG. 10, one or more head end communications interfaces 202 are provided. Each of the head end communications interfaces 202 can communicate with any one of a plurality of wireless communications media 204, such as separate, existing paging systems. A plurality of remote media interface gateways 206, each responsive to a particular one of the wireless communications media 204, are also provided. Each of the remote media interface gateways, in turn, is coupled to one or more local network function modules indicated generically at 208.

As previously noted, one important function of the pager-based communications systems described herein is to broadcast a single message or item of information over a wide area serviced by a wireless communications medium. Such a function can be served, for example, by transmission of an alphanumeric character message to one or more remote locations for emergency or disaster warnings, such as severe weather, a chemical spill or other such local, hazardous environmental condition. This function requires the ability to reach a wide range of remote locations organized by specific groups or even a single location.

In operation, a message or data string is sent by one of the wireless communications media or transmitters 204 to one or more of the paging receivers 208. This can be accomplished using known, one-way, telephone dial up modem, alphanumeric paging techniques. A single base

address sent by the transmitter 204 to all receivers 208 within the service area, activates each of the receivers 208 responsive to the base address in the conventional manner. However, additional subaddress information, included in the message itself or otherwise appended onto the base address, is decoded and used by the individual receivers 208 in the manner previously described, to determine whether they are part of the predetermined subgroup for which the particular message or information is intended.

Given the capability of the pager-based communications systems described herein to address preselected or determined subgroups among all the selective call receivers located within the pager service area, various desirable ends can be achieved.

One example of a function for which the selective call communications systems described herein can be used to advantage is to define particular subgroups according to some predefined selection criteria, a such as standard industrial classification (SIC) codes, arbitrary geographical boundary areas as dictated by tornado paths, or governmental boundary areas. By adding such selection information into the message and thereafter decoding it in the individual receivers 208, the receivers 208 can, on an individual basis, determine whether they are part of the intended receiving group. If not, they can ignore the message. If they are, they can respond as is appropriate. The various pager-based communications systems described herein can be used to contact anywhere from one single receiver up to all the receivers in various combinations or subgroups.

One important mode of operation is in using the pager-based communications system to contact receivers within a defined geographic subarea of the overall service area. One way to achieve this is through use of the latitude and longitude grid method depicted in FIG. 11. In this method and system, the agency generating or originating the message defines the intended receipt subgroup in terms of location within a rectangular area bounded by known geographic coordinates.

In FIG. 11, it is assumed that the message is intended for all receivers within the rectangular area bounded by the four geographic coordinate points 210, 212, 214 and 216. The geographical coordinates are selected to correspond with the actual physical location of the area for which the message is intended and is preferably generated using a geographical map generated by a computer and displayed on a screen within the agency generating the message. By highlighting an individual area on a computer based mapping system, individual coordinates can be established for any point. By selecting four grid coordinates, a rectangular area defined along actual longitude and latitude lines, an area of desired contact can be established. By selecting and using the paging system to broadcast these four points, individual receivers 208 can determine whether they are contained within the selected area and can act accordingly.

As shown in FIG. 11, a very simple subtracting method is used by each individual receiver to determine whether it is present within the selected area. In North America, for example, the receiver 208 is within the selected area if its known geographical coordinates are such that its

latitude is less than the latitudes of points 210 and 212 but greater than the latitudes of points 214 and 216, and if its longitude is less than the longitudes of points 210 and 214 but greater than the longitudes of points 212 and 216. A simple algorithm resident in each receiver 208, along with pre-installed information regarding the receiver's physical location can be used to determine whether the receiver is within the intended reception area.

More sophisticated methods can be used to select reception areas having shapes other than the simple rectangle shown. For example, multiple coordinates can be specified by the originating agency and transmitted via the paging system to define a selected reception area that is polygonal in shape. Still more sophisticated techniques can be used to define an arbitrary shape. Various algorithms can be used both in the head end communications interfaces 202 and in the function modules 208 to achieve these ends.

Still another advantageous feature that can be incorporated into one of the pager based communications systems described herein is the ability to use single or multiple message launch sites. In other words, a message that is to be transmitted to a one or more receivers can originate at more than one site and can be transmitted over the service area via one or more transmitters. In any event, the same base address is used, and only one base address need be procured from the pager service provider. This helps keep the system economical. Additionally, each additional launch site can be provided with similar or identical software, which provides redundancy in the event of a disaster without significantly increasing cost.

Another feature that can be incorporated is the ability to provide for over-the-air registration of individual receiving devices 208. This can be accomplished by correlating individual receiver identification numbers and address information (both longitude and latitude grid locations and governmental boundaries) to individual message launch sites. Thereafter, this information is sent to the individual receiver 208 using whichever transmitter 204 is connected to the originating message generating site. This feature also enables individual receivers 208 to be reused at a different address or location by over-the-air re-registration of the receiver 208.

Still another feature that can be incorporated is the ability to provide user authentication of the actual individual who generates the message sent to a paging transmitter 204. This increases system security by limiting access for sending messages and thus helps avoid the transmission of unauthorized messages. User authentication can be achieved by adding pass/challenge software at both the message launch site and the computer that controls access to the paging transmitter 204.

Still another feature that can be incorporated is the ability to generate time sensitive, self deleting messages that automatically erase themselves after passage of a set period of time. This feature can be implemented by inserting an additional item of information into the message that defines the length of time the message should remain in effect. The individual receivers 208 use the time out information to either retain the message or to delete it from memory if the message

is stale. This feature can be used to achieve the automatic resetting of all features in the receiver 208, and provides for hands off, automatic operation. This can be of value for use in spaces, such as hotel rooms, where continuous occupancy is not feasible.

Still further refinements can be made through the inclusion of suitable control commands embedded in the messages sent to the individual receivers. In particular, an embedded code can control the amplitude, duration and pattern of audio alarms and visual annunciators so that emergency messages convey urgency audibly and visually.

Still further refinements can be made through the inclusion of suitable first digits in the command portion of the message which defines the organization and content of subsequent groups of subaddresses so subaddresses can have different representations such as latitude and longitude coordinates, or governmental units.

Still further refinements can be made by the inclusion of a digit or character string in the control portion of the message specifying a message identifying number and by incorporating additional selective call receiver functionality. When the selective call receiver recognizes that the informational portion of the emergency message is null or contains some preassigned, rarely used character or character string, the receiver interprets this condition as an indicator to delete a previously stored message having the same message identifying number as that associated with the immediate deleting message.

Still further refinements can be made by using another digit or character string in the

control portion of the message which specifies the amplitude, duration and pattern of the audio and visual annunciators of the receiver to convey the urgency of individual emergency messages.

A second important operating mode for the selective call emergency notification communications systems herein shown and described is (a) the delivery of control commands and messages to a remote location, (b) the correct routing to the particular device required to receive the command or message, and © the combination of different technologies into special use receivers intended for use within the system. One such special use receiver is shown at 218 in FIG. 10 and functions to forward emergency messages from one system to another paging system. In other words, the receiver 218 receives an emergency message from the selective call communications system of which it is a part, and, if appropriate instructions are received, forwards the message on for reception by other receivers 220 that are part of a different selective call system.

To accomplish this function, the special receiver 218 includes a repeating receiver media interface. The receiver 218 receives any emergency message sent from one of the head end communications interfaces 202, but then strips off all additional sub-address information, thereby leaving the actual message. The actual message is then communicated to another pager transmitter for broadcast to pagers that are not a part of the main system or included in the original subgroup of receivers. This feature allows any paging carrier to utilize messages originally sent in the first or host system even if the frequency or signaling protocol is different

from the host system. Compatibility is thus assured.

A similar concept can be used to interface the system to other radio based systems such as all digital personal communications systems and other such specialized radio based systems such as IVDS (Interactive Video Data Systems).

Still another feature that can be implemented is the capability of linking with other local premise based transmitter devices such as baby monitors, telephone monitors and door bell ring detectors. These are particularly useful to the hearing impaired who cannot respond to ordinary sound-based signals. Such devices can be linked to a transmitter that generates a signal received by one of the receivers 208. Previously encoded messages are sent by the transmitter in response to receipt of an appropriate signal from the detector and are sent to the appropriate receiver 208 where they are decoded. The receiver 208 then generates an appropriate display to alert the user. This feature can be incorporated into a special selective call repeater system consisting of a selective call receiver that responds to two sources of selective call signals where one source is the emergency notification communications system and the other source is an on-site selective call system. The on-site selective call system responds to door bell, telephone and other common household activities or sounds and includes a low power transmitter. The two-source selective call receiver generally uses a vibrating alarm indicator to aid persons who cannot hear sound-based warnings, signals or messages.

Still another feature that can be implemented is a roving receiver 222 capable of

receiving localized messages while moving within or through an affected space or area. Such a receiver 222 can be equipped, for example, with a global positioning system (GPS) receiver 224 that monitors the geographical position of the receiver 222 and supplies positioning information that can be used by appropriate circuitry within the receiver 222 to determine whether the receiver is within the geographic area specified by the message originator and encoded into the signal broadcast by the transmitter 204. If the receiver 222 is within the specified geographic area, the message is displayed. If it is not, the message is ignored. This feature can be implemented over a very wide area such as the entire United States by monitoring selected CAP (variously, Code Assignment Plan or Capture) codes. These codes can be operated by using another receiver 208 in the system that strips off any other sub-address information, but only sends out the desired geographical information (i.e, latitude and longitude) along with the main message. The roving receiver 208, upon receiving the appropriate capture code and verifying presence within the intended geographic area, would then strip off the location grid information and only display the desired message.

Another pager-based, "one way broadcast" communications system 300 is shown in FIG. 12. In this system, the transmitting devices, i.e., the head end communications interface 12, the head end media interface 14, the telephone network 18 and the paging network 20 are as previously described. The remote media interface gateway or receiver 302, however, is different.

The receiver 302 used in the system 300 is

adapted to remain operational in the event utility based power is lost. Such power failures are not uncommon when emergencies or natural disasters occur. To avoid losing the capability of receiving emergency messages just at the time communication is most important, the receiver 302 includes an internal battery 304 that automatically switches in to supply operating power in the event line current is lost.

As illustrated, power for the receiver 302 is ordinarily provided by a power supply 306 operating from ordinary 120 VAC current. Preferably, the receiver 302 comprises a self contained unit that "plugs into" a standard, residential 120 VAC outlet. The power supply 306 rectifies, filters and regulates the incoming power in known manner to supply the requisite operating voltage and current to the various receiver 302 sub-circuits. In the event line current is lost, the battery 304 automatically switches in to continue powering the receiver 302.

The battery 302 is kept at full charge by means of a charger 308 that operates from the 120 VAC line source. The charger 308 supplies current to the battery 302 as needed to keep the battery 302 at full charge. In the event of a power failure, the battery thus operates the receiver 302 beginning with a full charge.

The receiver 302 contains a message display 30 and a wireless receiver 36 that can be the same as or similar to these respective elements of the previously described receiver or remote media interface gateway 16. In addition, the receiver 302 includes a plurality of light emitting diodes (LEDs) 310, an audible alarm or transducer 312 and a

plurality of control buttons 314 that enable the user to control the operation of the receiver 302. Each of these elements is coupled to a control microprocessor 316 that controls the overall operation of the receiver 302 and that can be programmed in a variety of ways to achieve various desired results. Depending upon how the control microprocessor 316 is programmed, a variety of various, specialized receivers can be realized.

One such specialized receiver that can be used as part of the systems herein described is a combination receiver and rechargeable battery-powered flashlight 226 (FIG. 10) This device 226 would normally be plugged into a standard 120 VAC outlet or source for continued powering, but would also operate from a self contained rechargeable battery kept charged by a self contained battery charger. In addition to the capabilities of the standard receivers 208, the receiver 226 would also contain a battery source and a light source, such as an illuminating lamp or high intensity light emitting diode. Another feature that can be advantageously included is the ability to provide a rapid flashing signal using a momentary on/off button that would also extend battery charge life by minimizing extended operation. On important aspect of the receiver 226 is the dual powering function wherein the receiver 226 is powered in a normal operating mode from a 120 VAC outlet. The receiver 226 is designed to remain plugged into the wall outlet during normal use. The internal battery allows the receiver to remain operational in the event of a power failures that frequently occur as a consequence of emergency or natural disaster conditions. The light source incorporated into the

receiver can be used for emergency lighting. Additionally, the receiver 226 can be operated from the battery of a vehicle to permit mobile operation or can be worn on a belt to permit personal, mobile operation.

Other such specialized receivers could incorporate smoke alarm, carbon monoxide detectors or other human and property safety devices into a common unit.

Still further benefits may be realized by incorporating two-way signaling devices and protocols so as to automatically notify a "911" or other emergency center of a fire or other hazardous condition at the earliest possible time or when occupants of a site are absent or unconscious.

Although the invention has been shown and described in its preferred form using a wireless communications system such as a paging system, it will be appreciated that the invention is not limited in its broader aspects to paging systems or even to wireless communciations systems. For example, the invention can also be used in connection with alternative forms of communication and message delivery such as wireless telephones, the internet, hardwired computer systems, television or other broadcast receivers or combinations of such devices.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications can be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

CLAIMS:

1. A method of operating a wireless system so as to communicate messages to specific groups among a plurality of potential message recipients according to the presence or absence of the potential message recipients within a specified geographic area, comprising the steps of:

equipping each of the potential message recipients with a wireless receiver operable to receive encoded geographic coordinates and to determine presence or absence within an area defined by the received encoded geographic coordinates;

identifying the geographic coordinates defining the specific geographic area to which the group specific message is directed,

transmitting to each of the receivers a message containing an informational portion and a portion containing the geographical coordinates of the specified geographic area,

determining at each of the receivers presence or absence within the specified geographic area, and

displaying the informational portion of the message at the receivers determined to be within the specified geographic area.

2. A method of operating a pager-based communications system having a plurality of receivers each responsive to a common base address and to a unique individual address, comprising the steps of:

generating for each of the receivers a unique identification code;

locating each of the receivers at a specific geographic location;

generating for each of the receivers a

location code indicative of the specific geographic location associated with the receiver; and

communicating via a wireless communications link the unique identification code and the location code to respective ones of the receivers.

3. A method as defined in claim 3 comprising the further steps of:

relocating a receiver to a different geographic location;

generating a new location code indicative of the receiver's different geographic location; and

communicating via a wireless communications link the new location to the relocated receiver.

4. A method of operating a wireless system so as to communicate group specific messages to specific groups among a plurality of potential message recipients, comprising the steps of:

identifying specific groups among the plurality of potential message recipients;

assigning to each of the identified specific groups a group specific address;

equipping each of the potential message recipients with a wireless receiver responsive to the group specific address of the specific group to which the potential message recipient belongs;

generating a message containing an informational portion and an address portion, the address portion including the group specific address of the specific group intended to receive the message;

transmitting via a wireless signal the message over a geographic area containing the potential message recipients so that the receivers responsive to the group specific address will accept the message and communicate the informational

portion of the message to the member of the specific group; and

verifying the existence of authority to transmit the message to the specific group before transmitting the message to the specific group.

5. A method of operating a wireless paging system so as to communicate group specific time sensitive messages to specific groups among a plurality of potential message recipients, comprising the steps of:

identifying specific groups among the plurality of potential message recipients;

assigning to each of the identified specific groups a group specific address;

equipping each of the potential message recipients with a wireless receiver responsive to the group specific address of the specific group to which the potential message recipient belongs;

generating a message containing an informational portion, an address portion, and a time duration portion, the address portion including the group specific address of the specific group intended to receive the message;

transmitting via a wireless signal the message over a geographic area containing the potential message recipients so that the receivers responsive to the group specific address will accept the message and communicate the informational portion of the message to the member of the specific group;

decoding the time duration portion of the message to define a time period; and

deleting the informational portion of the message following expiration of the time period.

6. A method as defined in claim 5

comprising the further step of resetting each of the receivers following expiration of a predetermined time interval.

7. A receiver unit for use in a pager-based communications system operable to direct messages to specific groups of pagers within a larger group of receivers within the service area of the system comprising:

a wireless receiver responsive to a base address;

a decoder coupled to the wireless receiver for recognizing a group-identifying indicator indicative of inclusion within the specific group;

an audible alarm annunciator responsive to the wireless receiver and the decoder for sounding an audible alarm in the event of receipt of an alarm message directed to the receiver unit; and

control circuitry for silencing the audible alarm after passage of a predetermined time period following receipt of the alarm message.

8. A receiver unit as defined in claim 7 wherein the control circuitry is further operable to reduce the audio level of the audible alarm in response to appropriate control signals received from the wireless receiver.

9. A method of operating a pager-based communications system comprising the steps of:

generating a message having a base address portion, a control instruction portion and an informational portion;

transmitting the message via a wireless signal;

receiving the transmitted message on a receiving unit operable to respond to messages containing the base address;

decoding the control instruction portion of the message and, in response to receipt of an appropriate decoded control instruction, thereafter transferring the informational portion of the message to a different paging system for distribution over the different paging system.

10. A receiver unit for use in a pager-based communications system operable to direct messages to specific groups of pagers within a larger group of receivers within the service area of the system comprising:

a wireless receiver responsive to a base address;

a decoder coupled to the wireless receiver for recognizing a group-identifying indicator indicative of inclusion within the specific group;

an audible alarm annunciator responsive to the wireless receiver and the decoder for sounding an audible alarm in the event of receipt of an alarm message directed to the receiver unit; and

control circuitry for silencing the audible alarm after passage of a predetermined time period following receipt of the alarm message.

11. A receiver unit for use in a pager-based communications system operable to direct messages to specific groups of pagers within a larger group of receivers within the service area of the system comprising:

a wireless receiver responsive to a base address;

a decoder coupled to the wireless receiver for recognizing a group-identifying indicator indicative of inclusion within the specific group;

circuitry coupled to the decoder and the wireless receiver for recognizing an informational

portion of a message directed to the specific group of receivers, and

additional circuitry responsive to an informational input received independently of the message directed to the specific group of receivers.

12. A receiver unit as defined in claim 11 wherein the informational input comprises a signal indicative of the geographic location of the receiver unit.

13. A receiver unit as defined in claim 12 wherein the informational input is obtained from a global positioning system receiver.

14. A receiver unit as defined in claim 11 wherein the informational input is derived from a sensor located in the vicinity of the receiver unit.

15. A receiver unit as defined in claim 14 wherein the sensor is selected from the group consisting of baby monitors, telephone monitors and door bell ring detectors.

16. A receiver unit as defined in claim 11 further comprising a memory for storing one or more previously recorded messages and a display for displaying the previously recorded message in response to receipt of an appropriate informational input.

17. A receiver unit as defined in claim 11 further comprising a non-aural based indicator for indicating receipt of an informational input.

18. A receiver unit as defined in claim 11 further comprising an alternate source of operating energy.

19. A receiver unit as defined in claim 18 wherein the alternate source comprises a battery-operated power supply.

20. A receiver unit as defined in claim 19

further comprising a light source actuated upon actuation of the alternate source.

21. A method of operating a communications system comprising the steps of:

generating a message having a base address portion, a control instruction portion and an informational portion;

transmitting the message via a signal;

receiving the transmitted message on a receiving unit operable to respond to messages containing the base address; and

decoding the control instruction portion of the message and, in response to receipt of an appropriate decoded control instruction, cancelling a previously received message.

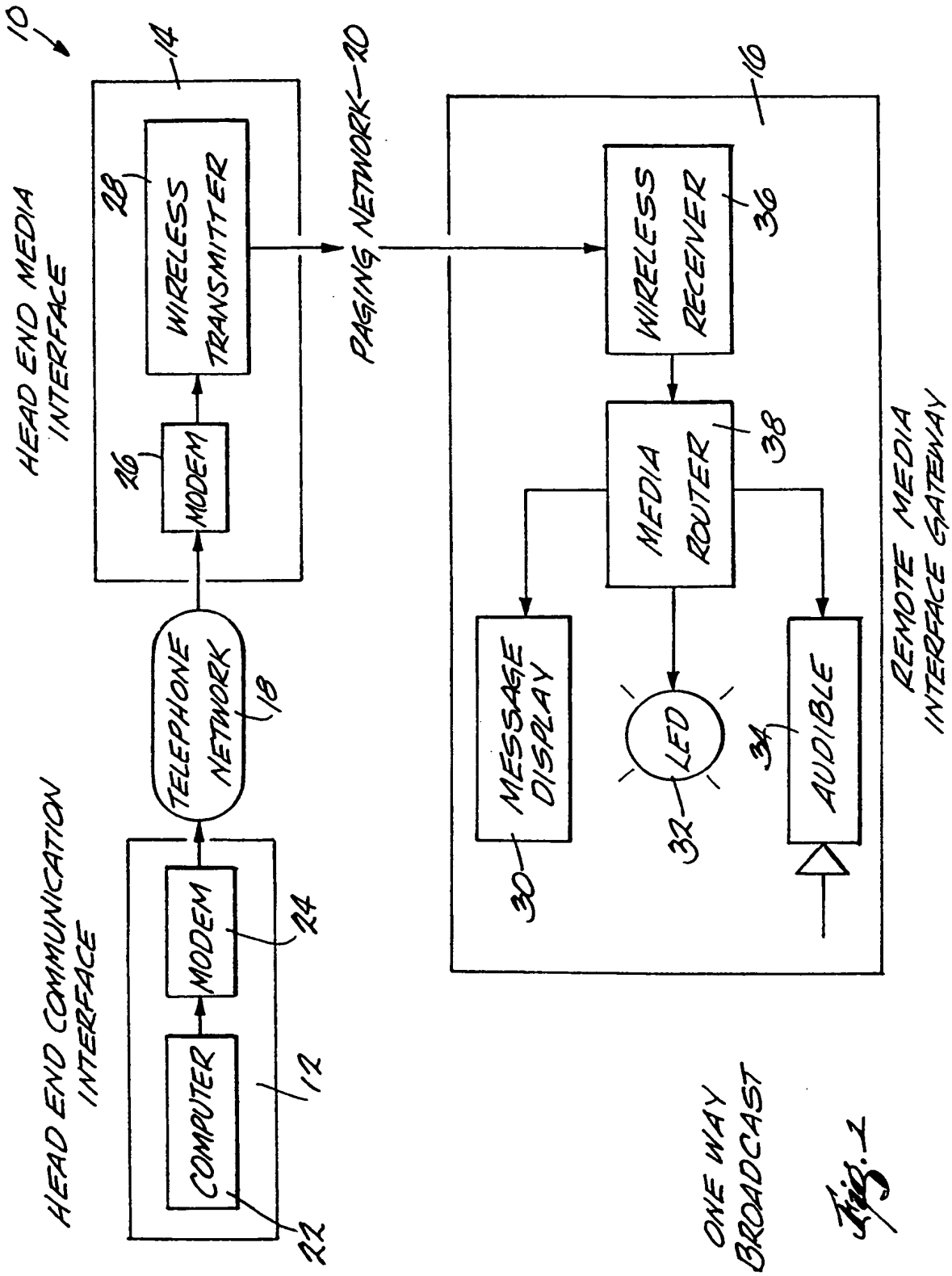


Fig. 1

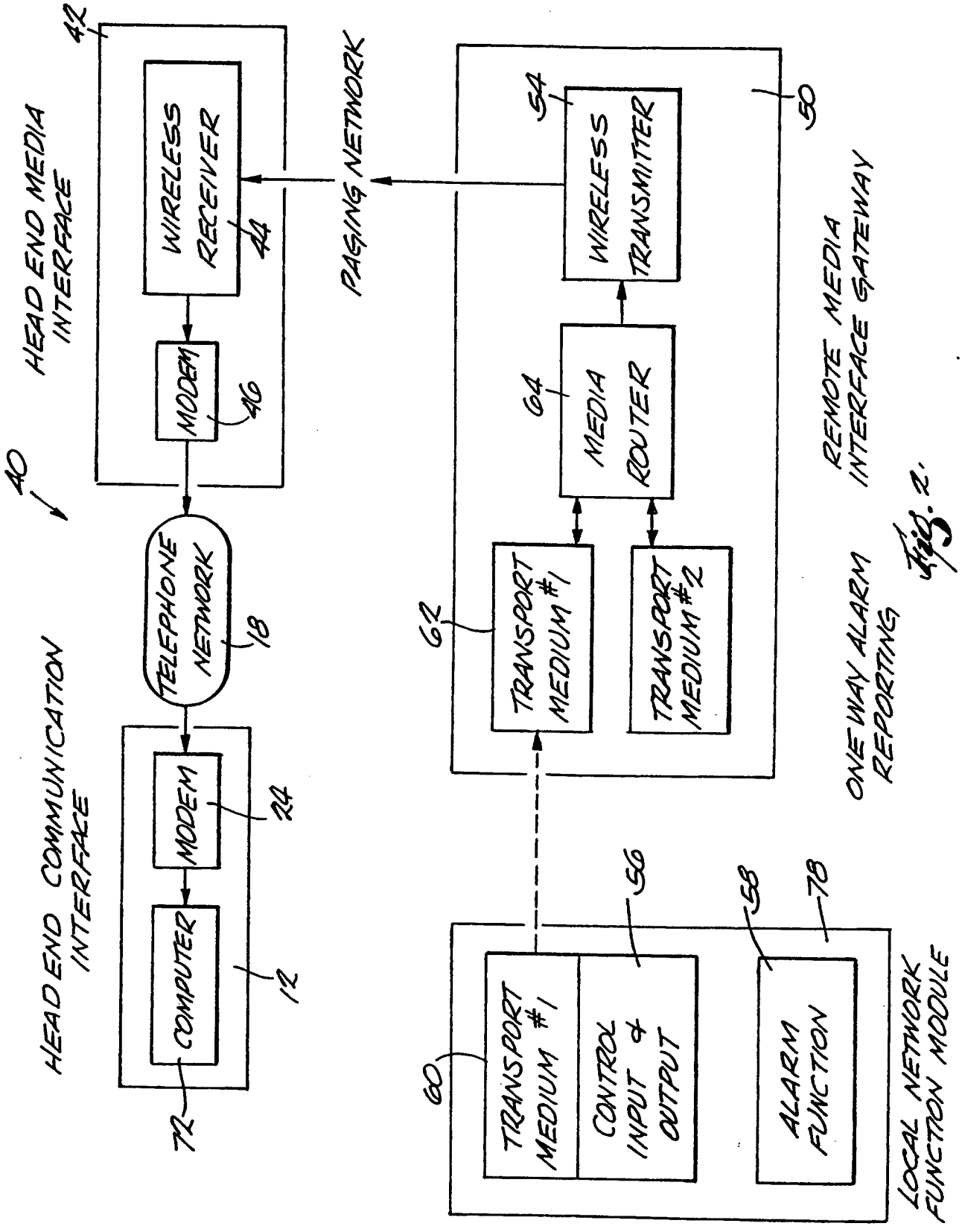


Fig. 2.

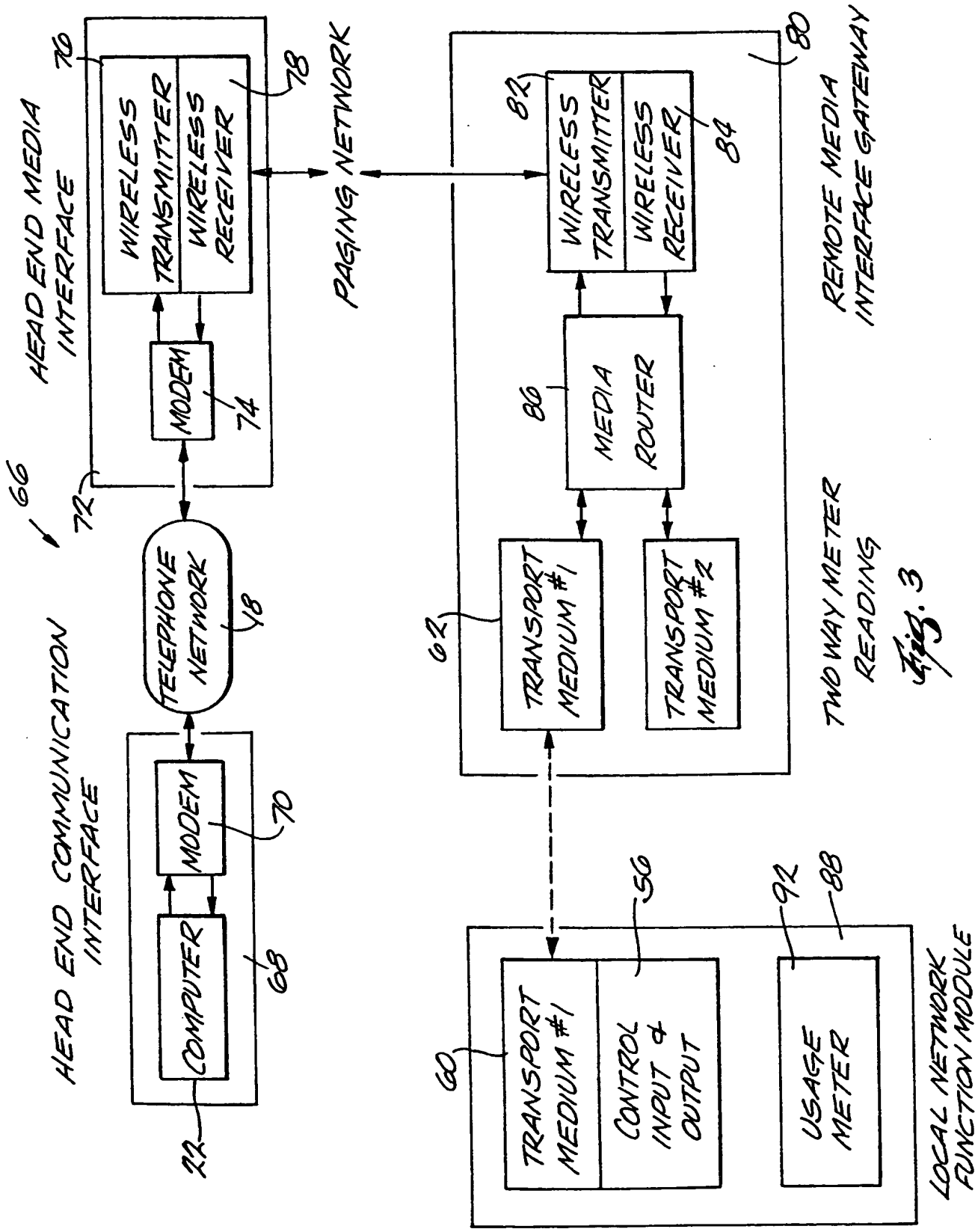


Fig. 3

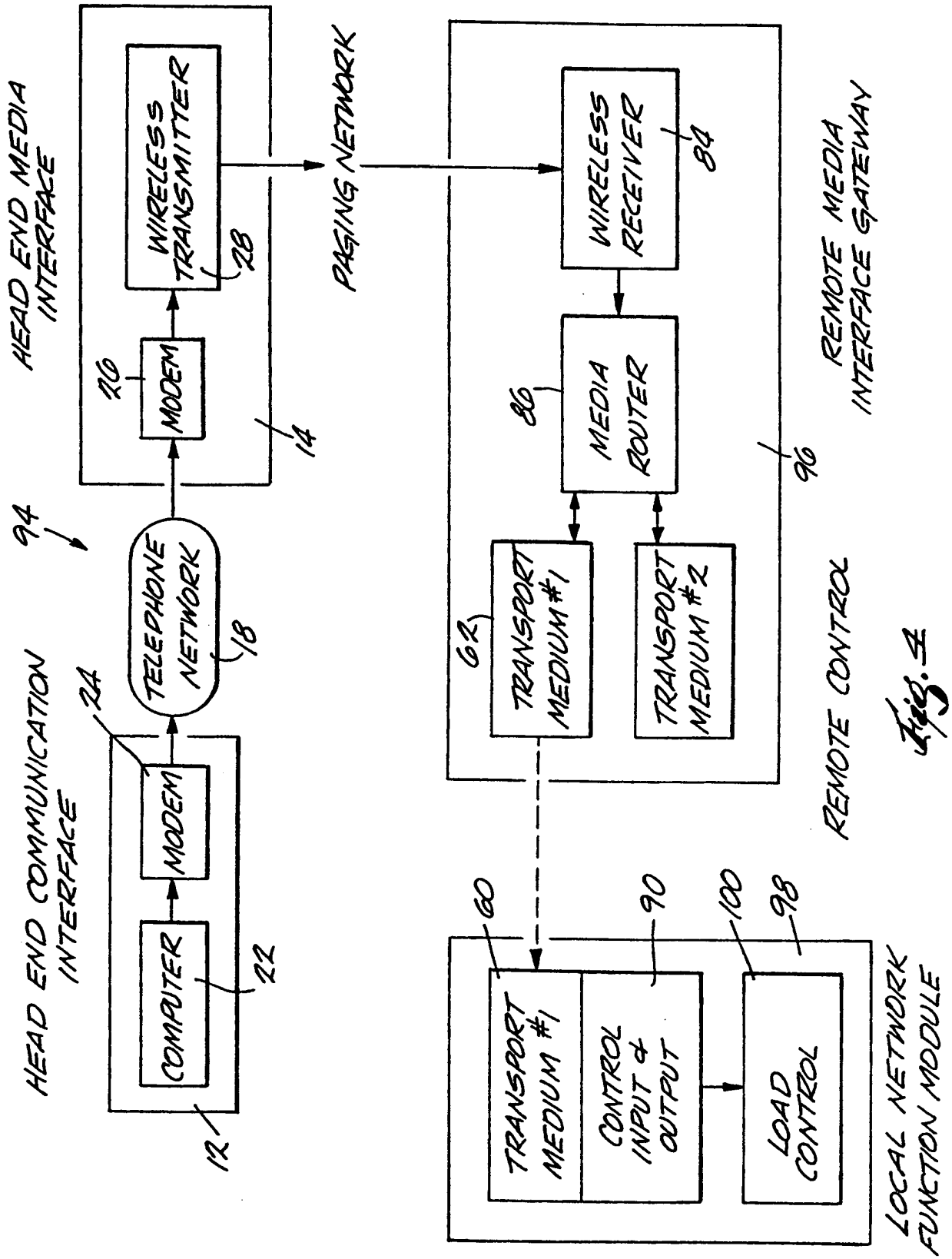


Fig. 4

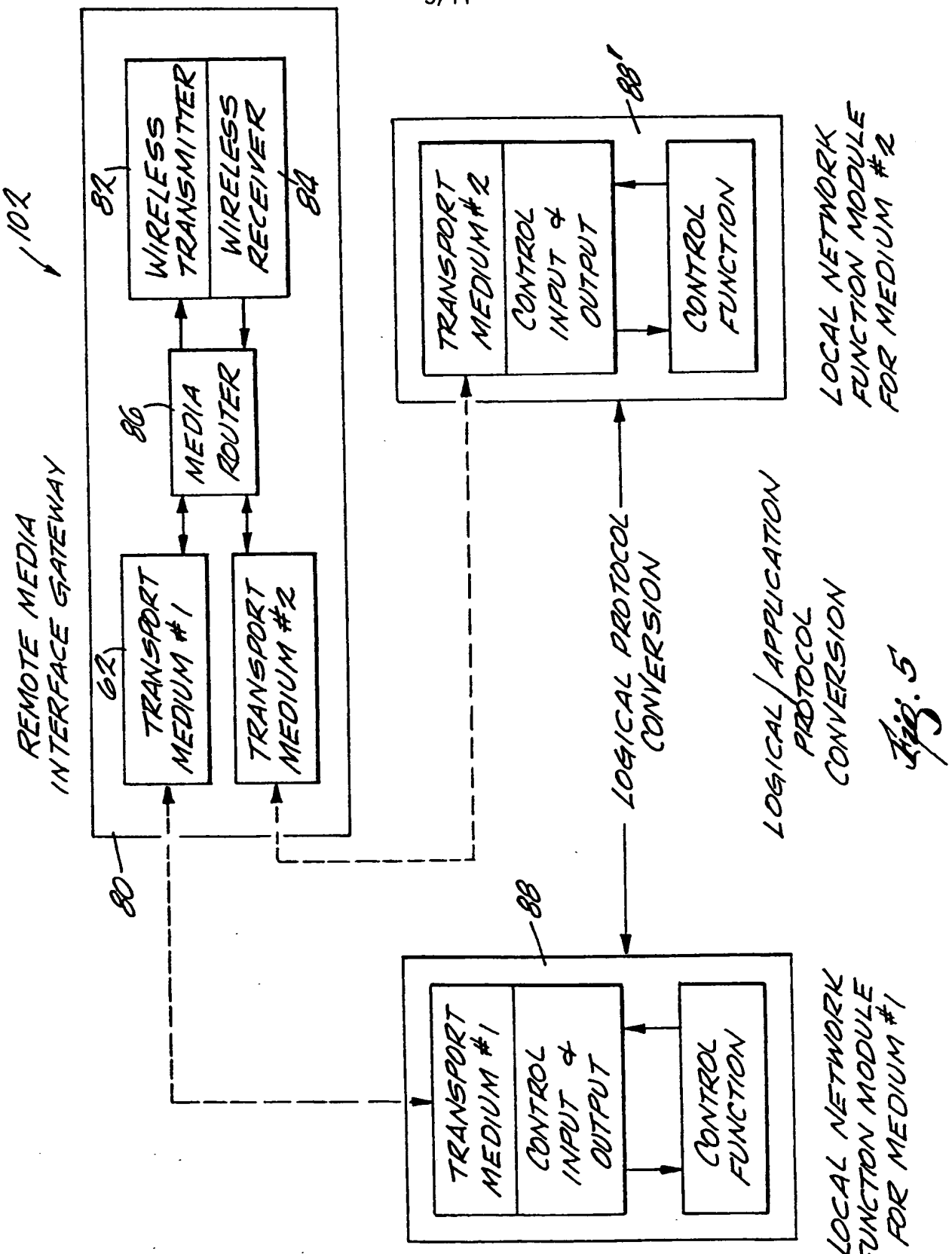


Fig. 5

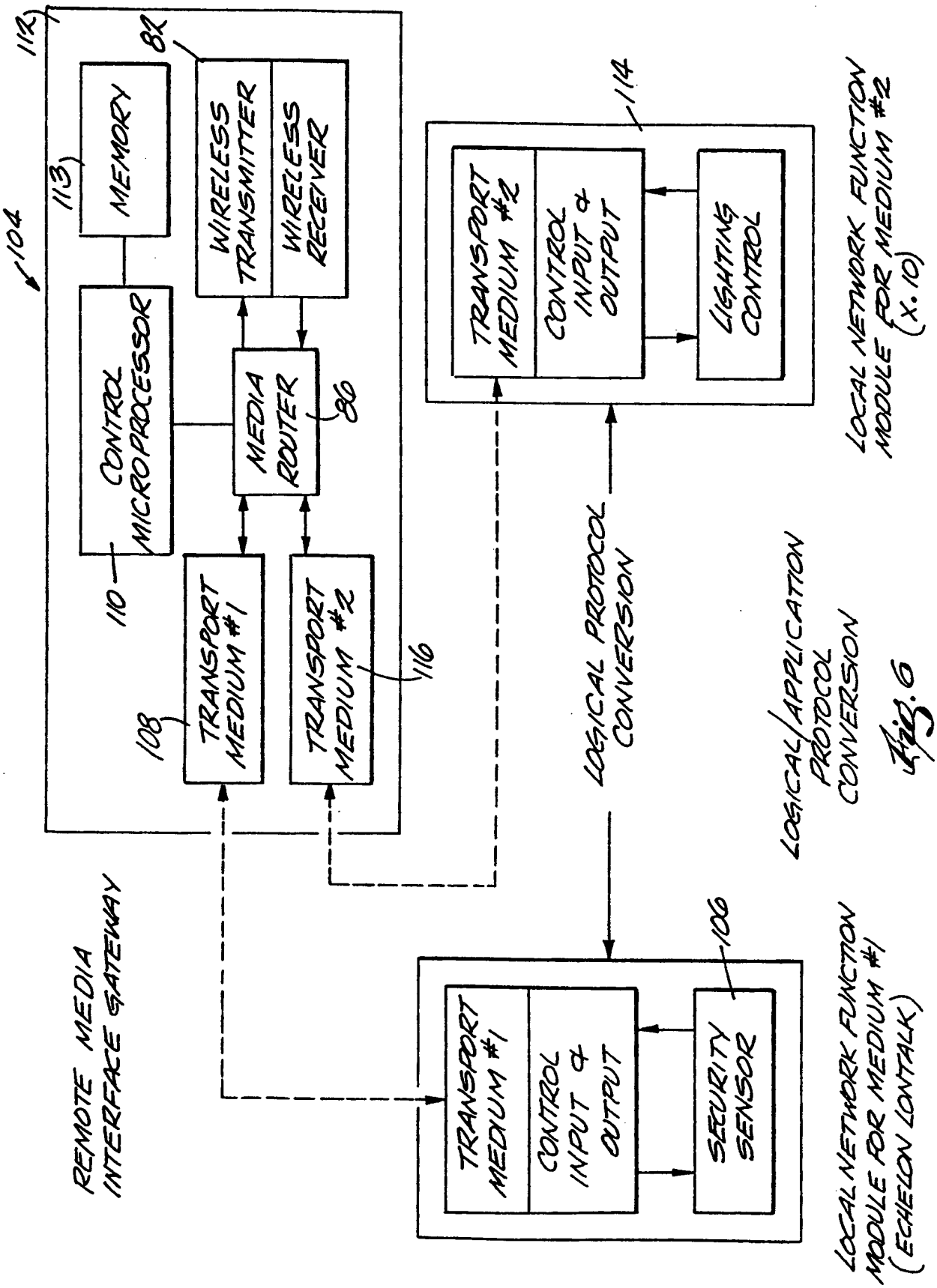
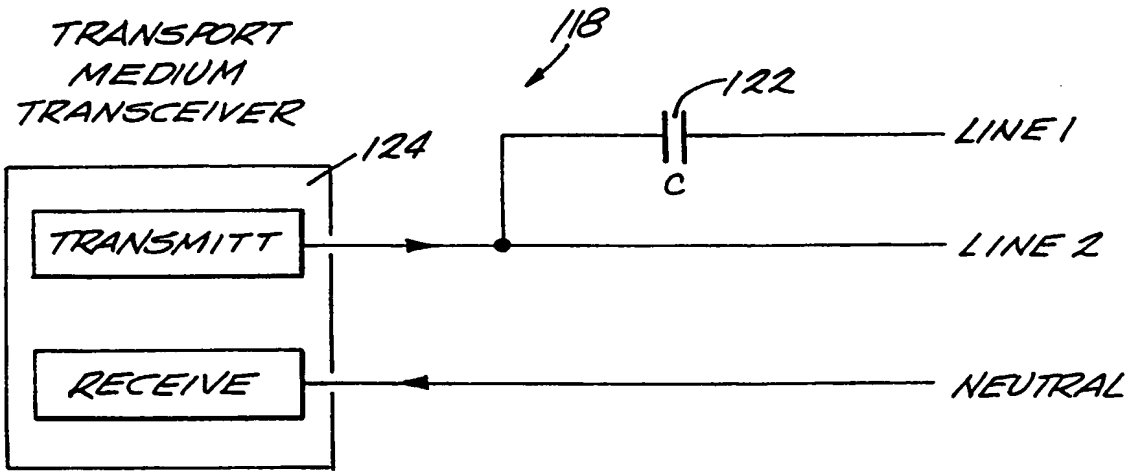
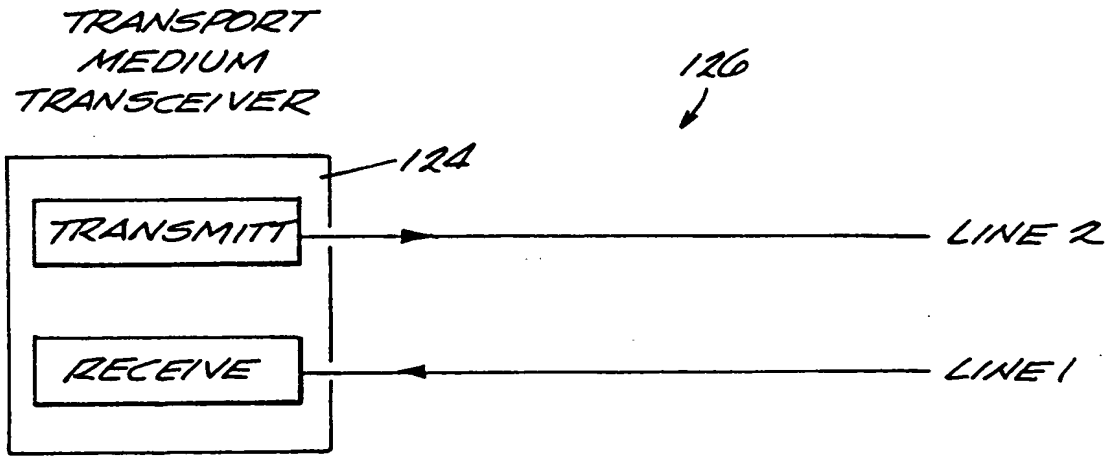


Fig. 6



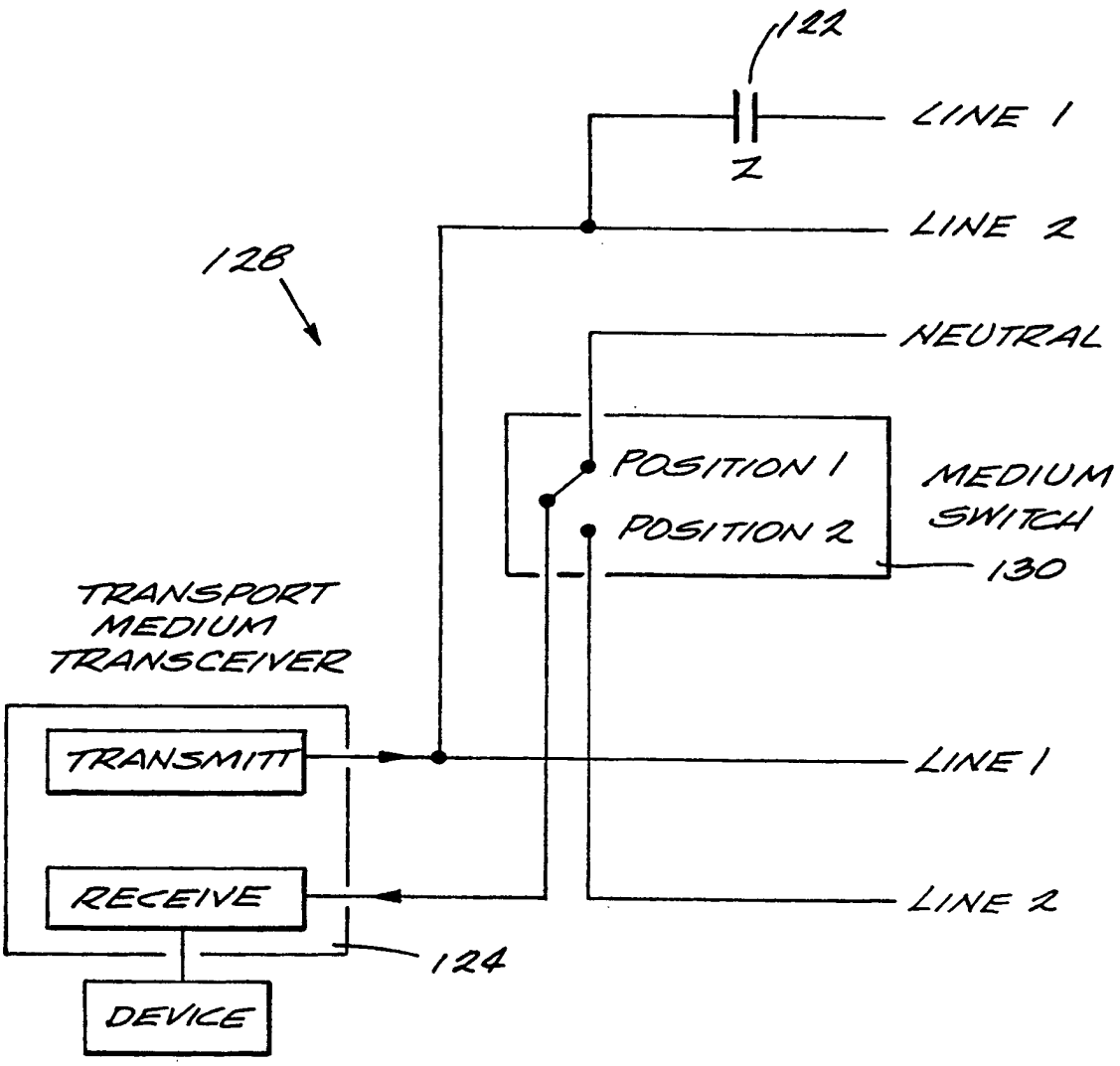
LINE 1- LINE 2 TO NEUTRAL CONNECTION

Fig. 7



LINE 1 TO LINE 2 CONNECTION

Fig. 8



LINE 1 - LINE 2 TO NEUTRAL CONNECTION
LINE 1 TO LINE 2 CONNECTION

Fig. 9

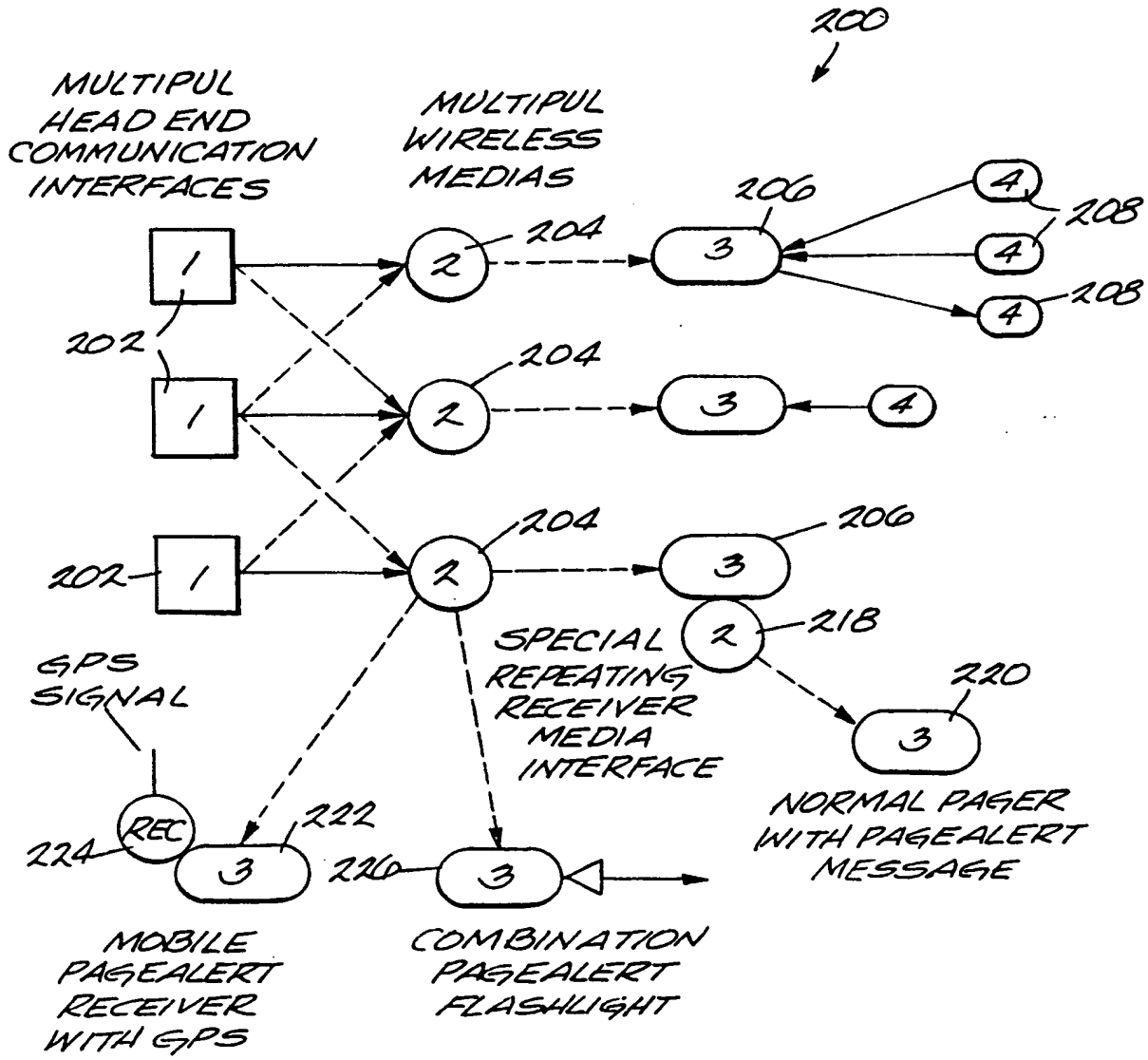
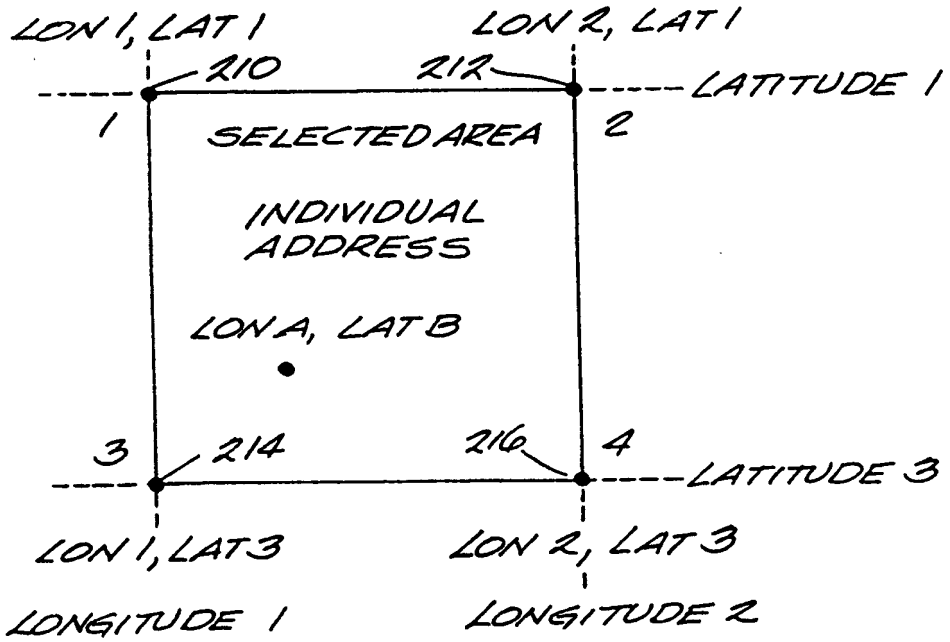


Fig. 10



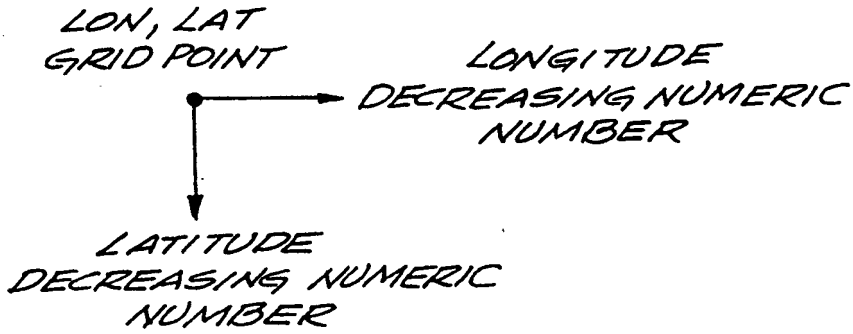


Fig. 11

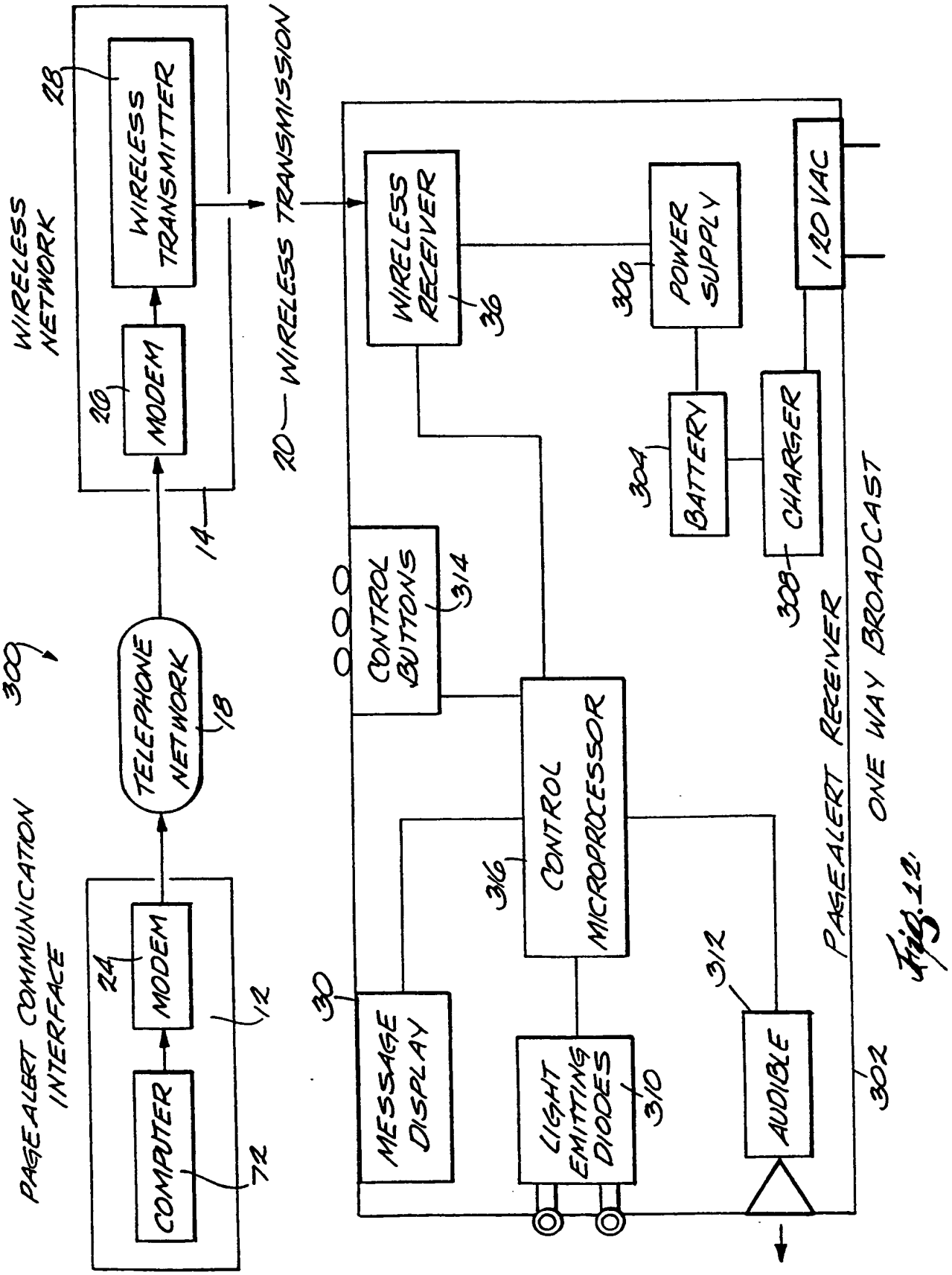


Fig. 12.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/08333

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G08B 5/22, 13/19; H04Q 1/00, 7/00; H04B 1/16
US CL : 340/825.44, 825.52; 455/58
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/825.44, 825.52; 455/58

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Aps
Searc terms: emergency, wireless, select?, group#, message#, recipient#, transmit?, receiv?, locat?, geographic, area#

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,077,830A (MALLIA) 31 December 1991, abstract, col 1 lines 22 - 26, col 2 lines 48 - 59, paragraph bridging col 3 and 4, col 4 lines 56 through col 5 lines 4, col 5 lines 5 - 14, figs. 1, 2, 4B.	1 - 6, 9, 12, 13, 21
X, P --- Y	US 5,635,914A (PETREYE et al.) 3 June 1997, figs. 1, 2, 11, 19, paragraph bridging col 12 and 13, col 14 lines 25 - 28, col 16 lines 33 - 37.	8, 10, 11, 17 - 20 --- 1 - 7, 9, 14 - 16, 21
Y	US 5,381,133A (ERHART et al.) 10 January 1995, figs. 6 and 7, paragraph bridging col 6 and 7.	6

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 23 JUNE 1998	Date of mailing of the international search report 09 OCT 1998
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JEAN JEANGLAUDE Telephone No. 703 - 305 - 2701

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/08333

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,894,649A (DAVIS) 16 January 1990, col 3 lines 25 - 32.	7
X	US 4,891,638A (DAVIS) 2 January 1990, abstract, fig. 2, fig. 3(A-B).	12, 13
Y	US 5,570,079A (DOCKERY) 29 October 1996, abstract, fig. 1.	14, 15
Y	US 5,459,458A (RICHARDSON et al.) 17 October 1995, fig. 1, paragraph bridging col 11 and 12.	16

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